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(54) Title: METHOD OF DETECTING THE PRESENCE AND LOCATION OF A GAS LEAK

(57) Abstract: The method includes the following steps: (i) About a reference point, a sensor is exposed to the atmosphere in a plurality of different directions until the sensor registers the transient presence of a critical component of the leaking gas above a threshold level, thereby to indicate a suspect direction, the sensor being exposed without mixing of the atmosphere; (ii) A second reference point is then selected in the suspect direction relative to the first reference point. Step (i) is then repeated about the second reference point.

Method of Detecting the Presence and Location of a Gas Leak

Field of the Invention

The present invention relates to a method of detecting the presence and location of a gas leak, such as a leak of natural gas.

Background of the Invention

Gas leak detection is an important safety issue to most oil and gas industries. In the United Kingdom there is a network of over 0.25 million kilometres of pipe. Gas leaks present a hazard across the entire gas chain, from offshore gas and oil exploration and production, through to the processing, transmission, storage and distribution of gas onshore, to its utilisation by industrial and domestic customers. Many thousands of engineers are engaged in the United Kingdom in day-to-day gas detection activities in response to typically half a million public reported escapes per year.

Conventionally, emergency response teams are equipped with gas detectors to locate a gas leak. When the plume of gas from a leak is detected, the engineers have to scan the area very slowly and in all directions by trial and error to find the source of the gas leak. However, such a method is time consuming and unreliable as the engineer must walk around randomly trying to find the source of the gas leak. The overall time to detect a leak in open ground is dependent on how quickly and successfully the operator can identify the site of a first gas sample and since this activity requires a random sweeping action of the sampling probe until such time as an indication of gas concentration is received, considerable time is wasted in detecting the first gas concentration measurement.

Response time of gas detection instruments is an important parameter in the selection of portable equipment used for identifying the source of a gas leak. For walking surveys a few seconds response time is normally considered acceptable when detecting gas leaks in the range of parts per million to low %LEL range, but for mobile surveys, e.g. from vehicle mounted equipment, faster response is required.

It has not been the normal approach to place the sensor directly in the gas, even though a faster response can be expected because then it is only the response time of the sensor (and any signal processing) that determines the overall response speed. This is because the sensor would then be subject to a range of conditions that may affect its overall performance. For example, water will degrade or destroy some sensors or the sensor may simply not be robust enough for the application. The sensor is therefore housed in the instrument body, remote from the measurement point, and usually protected by a filter.

It is an object of the present invention to provide a method to reduce the overall detection time by reducing the time to locate the first gas trace and additionally through a fast response sensor to provide further time savings in locating the actual gas leak source.

Summary of the Invention

According to the invention, there is provided a method of detecting the presence and location of a gas leak, the leaking gas comprising a critical component, the method including the following steps:-

(i) about a reference point, exposing a sensor directly to the atmosphere in a plurality of different directions until the sensor registers the transient presence of the critical component above a threshold level, thereby to indicate a suspect direction, the sensor being exposed without mixing of the atmosphere;

(ii) selecting a second reference point in the suspect direction relative to the first reference point; and

(iii) repeating step (i) about the second reference point.

We have undertaken extensive work in evaluating the performance of gas detection instruments in a wind tunnel where natural gas leaks have been simulated. We have surprisingly discovered that at the edges of an expanding leaking gas plume, the concentration of the leaking gas does not fall continuously as might be expected, but yet there is no sharp boundary wall either. In fact, it appears that wisps of the leaking gas, occupying relatively little space, extend into the surrounding atmosphere, representing wild fluctuations in gas concentration. Most gas detection systems appear unable to detect these wisps of gas. It is thought that the sampling processes which are used, often involving pumping the gas along a sampling tube, result in such mixing of the gas with the atmosphere that the concentration drops below the noise threshold of the sampling system. We have discovered that this mixing is a function

of the pump rate, sampling tube diameter, probe length, and sampling geometry. Alternatively or additionally, the output of the sampling system is averaged over time, again reducing the measured gas concentration to a level below the noise threshold.

Therefore, although leaking gas is present, it has not been possible to detect it at the very edges of the gas plume.

Time must therefore be wasted until the operator moves well into the gas plume, so that the detecting system can provide a recognisable output despite these mixing and averaging effects.

The present invention is based upon the discovery that gas at the edges of an expanding plume can be detected by avoiding such mixing and averaging effects and by progressively moving in the suspect direction.

The critical component will generally be methane where, for example, the leaking gas is natural gas. The invention is however not limited to the detection of fuel gas such as natural gas. When other gas detectors are used, the invention can find broad applications in chemical refineries and storage plants and for environmental pollution monitoring purposes.

Preferably, the threshold lies above an average background value for the critical component. For example, in the case of methane, a typical average background level is 1.7 ppm, the threshold for the method according to the invention can be set at, for example 10 ppm.

The sensor may be exposed to the atmosphere in a plurality of different directions about a reference point by sweeping the sensor around the reference point and continuously monitoring the output thereof.

The sensor is preferably selected from naked flame ionisation based devices and open path optical devices.

Optical sensors inherently have very fast response times as they are not subject to, for example, thermal response delays found in many sensors. An optical sensor with scratch resistant (e.g. sapphire) windows is a sufficiently robust device, and apart from occasional surface cleaning will withstand normal gas detection duties, being generally less affected by water than other sensor devices.

The optical device may have an open path of at least 0.5m, typically from 0.5 to 1m, for example 0.5m. This is especially convenient where the device is to be hand held.

Flame ionisation sensors are also inherently fast, again because of the lack of thermal mass in the system.

In an embodiment of the invention, the wind direction at the first reference point is measured and the selection of the second reference point takes account of the measured wind direction.

Service gas pipes tend to be of small diameter, and therefore, where the route of the pipe is already known, then walking the pipe with a wide open path detector will lead to more rapid identification of the leak site. If the pipeline layout information is provided as data in the form of a computerised map held in a computing means, the point at which gas is detected and the upwind direction at that point can be entered into the computing means, for example, by entering appropriate co-ordinates. The computing means can then determine the intersection of one or more pipelines with the wind direction from the point at which gas was detected to provide the most likely gas leak source location.

Claims

1. A method of detecting the presence and location of a gas leak, the leaking gas comprising a critical component, the method including the following steps:-

(i) about a reference point, exposing a sensor directly to the atmosphere in a plurality of different directions until said sensor registers the transient presence of said critical component above a threshold level, thereby to indicate a suspect direction, said sensor being exposed without mixing of said atmosphere;

(ii) selecting a second reference point in said suspect direction relative to said first reference point; and

(iii) repeating step (i) about said second reference point.

2. A method according to claim 1, wherein said threshold lies above an average background value for said critical component.

3. A method according to claim 1 or 2, wherein said critical component is methane.

4. A method according to any preceding claim, wherein said sensor is exposed to the atmosphere in a plurality of different directions about a reference point by sweeping said sensor around said reference point and continuously monitoring the output thereof.

5. A method according to any preceding claim, wherein the wind direction at said first reference point is measured and the selection of said second reference point takes account of the measured wind direction.

6. A method according to any preceding claim, wherein said sensor is selected from naked flame ionisation based devices and open path optical devices.

7. A method according to claim 6, wherein the sensor is an open path optical device and is provided with a scratch resistant window.

8. A method according to claim 6 or 7, wherein said optical device has an open path of at least 0.5m.

9. A method of detecting the presence and location of a gas leak, substantially as hereinbefore described.

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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Information on patent family members

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